

regrettable accident, it ought to be recognised as natural and desirable. If the real object of the examinations be to promote good teaching and sound learning, it is most important that, in setting the questions, the examiners should always keep in view their probable effect in giving direction to the studies of future candidates; and there can be no doubt that the men who are both most likely and most able to do this are those whose constant business it is to consider how the subjects in which they have to examine can be best brought before the minds of learners. Moreover, it is very difficult for examiners who are not also teachers, and teachers accustomed to pupils who are at about the same stage of advancement in their studies as the majority of the candidates, to know what amount of knowledge it is reasonable to expect. A man, however minute his own knowledge of his subject may be, generally soon forgets the exact steps by which he acquired it; and, unless he is in frequent contact with the minds of learners, he is no longer able to tell what, at any particular stage, it is creditable to know, and what it is disgraceful to be ignorant of. And again, though this perhaps is a less important consideration, the necessity which a teacher is under of periodically reviewing the whole round of his subject, is a great help towards a varied selection of questions.

With regard to the particular kind of questions which are most desirable in examinations like those of the University of London, I wish to say only a very few words. If the general considerations to which attention has been drawn in an earlier part of this lecture are of any value, it follows at once that examination questions in Physics ought to be selected with a view to testing the reasoning power and not the memory of candidates. If what are called *book-work* questions are admitted at all, they should be such as will bring out the power of reproducing trains of consecutive reasoning, and bringing facts to bear on the establishment of general conclusions, and not the power of simply recollecting individual facts. It may be said that such questions would be unfairly difficult. I can only say in reply that, if teaching were what it should be, I do not believe that this would be the case; but if it should be found to be so, I maintain that the inference is, not that any other style of examining in Physics should be adopted, but that the whole subject should be dropped. A late very distinguished member of the University once said that, in the case of candidates for Matriculation, all that could be fairly required at the examination in Physics was evidence of "correct acquisition." It would in my opinion be only a little more absurd to say that all that ought to be required at an examination in Geometry is evidence of the "correct acquisition" of Euclid. If Physics is not a subject upon which the intelligence should be exercised from the very beginning, it seems to me to be a waste of time to teach it at all.

The consideration of the kind of questions that are best fitted to be of use in promoting improved methods of teaching and learning, suggests a remark which bears upon the distinction that has often been pointed out between the subjects which it is desirable to teach and those which are most suitable for examinations. In the particular case of Physics, I am inclined to think that the very elementary parts of such branches as Heat and Electricity are not well adapted to form the subjects of examinations like those we are considering, where the examiners have no means of knowing the exact points of view from which the matters dealt with have been presented to the candidates. My reason for this opinion is the difficulty in these subjects of setting questions which require anything more on the part of candidates than mere exercise of the memory, and which at the same time are not unreasonably hard. As a practical inference, it appears to me that, if the amount of acquaintance with Heat, Electricity, and Magnetism represented by the London Regulations for the First B.Sc. Examination (supposing the

regulations to be strictly interpreted) is all that can be fairly demanded at this stage of a student's progress, it is at least a question whether these subjects should not be deferred until a more advanced stage, when something more than descriptions of apparatus or the solution of arithmetical problems might be reasonably required.

If any of my audience have listened to this lecture with the consciousness that they will soon be going up to one or other of the examinations that I have been discussing, it may very possibly seem to them that I have been pleading throughout for making these examinations more difficult. To any to whom this seems to be the tendency of my remarks, I would venture to suggest one or two further considerations. In the first place, I fully admit that if examinations in Physics were to be such as I have advocated, that is, if they required candidates to *think*, while the teaching of Physics remained what too much of it now is—a mere loading of the *memory*—candidates would, no doubt, have a hard time of it; but the whole intention of what I have said is that examinations should be improved *in order* that teaching may be improved through their influence; and I believe that if teaching were what it should be, good examinations would be found to be no more difficult than bad ones. I may also observe that after all the precise degree of difficulty which an examination presents is not the most important consideration even for an intending candidate; what it really is important, not only for candidates but still more for those who regulate examinations, to consider is, what is the permanent educational value of the work which an examination requires, and not simply what is the amount of work needed. I have many a time in reading examination papers felt sincerely sorry for the writers when I saw how much labour they had evidently gone through in order to learn nothing—nothing that is of real use—and have thought how much the same amount of labour might have accomplished if it had only been better directed; and I beg leave to assure any who look upon examinations from the under side, that I have no wish whatever to add to the quantity of work that is already required of them; but what I do wish sincerely is, that whatever work they may be required to do in preparing for examinations may be such that they will be intellectually better and stronger for having done it. It cannot be too often repeated that degrees and university distinctions are of no more value in themselves than the Queen's head upon the coin: unless the metal is genuine, the stamp only makes it into a lying counterfeit. This has been urged upon students over and over again; what I shall be glad if this lecture tends in any degree to accomplish, is to press the same truth upon the attention of our University authorities. It is important for them to remember that a man is not really either better or worse for all the degrees that they can give him; and that their boast should be, not in the length of their lists of graduates, but in the extent to which they have promoted "a regular and liberal course of education."

NOTES

ONE of the first results of the Transit of Venus expedition with regard to the geological aspect and vegetation of a comparatively little known island, comes to us from Rodrigues, and is contained in a communication from Mr. J. B. Balfour to Dr. Hooker, under date, from the above island, of August 23, 1874. As a proof of the inhospitable, or rather the uncivilised nature of the island, it is stated that the party belonging to the expedition were warned in Mauritius before starting for Rodrigues that they must take everything from the former island that they would be likely to require as it would be impossible to get anything at Rodrigues, and even labour is most difficult to be obtained. After providing himself with various articles of abso-

lute necessity, Mr. Balfour started from Mauritius, and after a voyage of exactly a week, landed at Rodrigues on August 18. The appearance of the island as seen from the vessel while steaming along near the coast, presented few features which could be looked upon as evidencing any large amount of granite entering into its constitution. On the contrary, the columnar structure of the cliff lines, both on the coast and in the interior, along with the terraced aspect of many of the ridges separating deep ravines, cutting far back into the island, clearly showed that, whether the main mass of the island were granite or not, certainly at some period of its history it had been the scene of very extensive volcanic action. On the 19th of August an excursion was made across the island to survey the channel on the south side. The vegetation on the island is very rank. The trees do not grow to any great size, and in most places do not form thick forest, but are scattered singly over the slope of the hills. It is only in the deep valleys and gorges that they grow into thick forest. The commonest tree seems to be the *Vacua* (*Pandanus*), of which there are probably at least four species. The under-scrub is very dense and very spiny, which renders walking through it by no means a pleasant task. Neither ferns nor mosses appear to be very abundant, but lichens are pretty plentiful, especially in their pulverulent state; and in many places the basalt was nearly covered with white powdery patches. The basalt forming the rocks near Port Mathurin is, in its unweathered condition, a very beautiful compact stone, with large crystals of several minerals scattered through it. The difficulties in landing upon the island seem to be very great, owing to the extent of the coral reefs.

THE Yorkshire College of Science at Leeds was opened without ceremony on Monday, by the delivery of one of the introductory lectures by Mr. A. H. Green, the Professor of Geology and Mining. The other professors—A. W. Ricker, Dr. T. E. Thorpe, and W. Walker—give their introductory lectures during the course of the present week, and the teaching of the session will then be proceeded with. Very suitable buildings have been obtained, containing ample accommodation, which has been fully utilised for lecture-rooms, laboratories, &c., which are well furnished with the necessary appliances. Still, as Mr. H. Brown said, "they must look forward to having a noble building like that of Owens College, Manchester;" if the College is to maintain its position and to advance at all, it cannot but end in this. The number of students enrolled is as yet small, but, no doubt, will gradually increase. Prof. Green, in his address, spoke of the importance of a thorough training in abstract science as the necessary groundwork of a technical education. "Before they could understand," he said, "the practical application of a science, they must be master of the science itself. What was sometimes understood as technical education was a sheer impossibility, and a contradiction in terms. They could not explain the technical application of a science without first laying down the scientific groundwork on which it rested. A science like geology could not be taught piecemeal. Technical education in the popular sense was a misnomer, because the teaching which would limit the range of a man's vision to the subjects of which he could see the use did not deserve the name of education, the very essence of which was the strengthening of the intellect by mental exercise. It was his earnest wish that he might be able to give a teaching which in the end would have an important bearing on their practical occupations, and enable them to manage their mining, engineering, and other pursuits—in the conduct of which a knowledge of geology came in useful—better than if they knew no geology at all. But if he was to succeed in doing so, he must begin by telling them many things which at first sight would seem to be of no practical value whatever." With such a spirit as these words indicate, animating the pro-

fessors of this new college, the best results may be expected from their teaching.

A MEETING of some of the friends of the late Dr. Stoliczka was held in the rooms of the Zoological Society on Friday, the 16th inst., at which it was determined to obtain, by subscription, a bust, to be presented to the Asiatic Society of Bengal, of which society Dr. Stoliczka was for some years before his death one of the honorary secretaries. A committee was appointed to act in concert with one previously formed in Calcutta, and upwards of 50*l.* was subscribed in the room for the purpose mentioned. Subscriptions, we are informed, will be received by Messrs. Grindlay and Co., 55, Parliament Street.

THE *Athenaeum* announces that the *Contemporary Review* for November will contain an account of a new scientific discovery by Prof. Tyndall.

AMONGST the works which are progressing favourably at the Observatory of Paris we may mention the determination of the velocity of light, by MM. Fizeau and Cornu. These able physicists are using for their second station the Tower of Montlhéry. The light is transmitted to Montlhéry through a refracting telescope of 12 in. and returned to the Observatory with a 7 in. The distance between the Observatory and Montlhéry being 26 kilometres, the total distance traversed by the ray of light is 52 kilometres. The space of time required amounts to something less than one-thousandth of a second.

THE polishing of the great reflecting telescope is almost completed. The immense lens to be covered with silver by the Leon Foucault process, is nearly ready. It is said that everything will be finished by the beginning of May 1875.

AT Agram, the chief town of Croatia, a Croatian University was formally opened on Oct. 19 by the highest magistrate of the land, who is called the Ban, and exercises a kind of viceregal power on behalf of the Emperor of Austria. The University is to be called "Francis-Joseph," from the name of its founder. The Rector delivered a very able oration, summarising the progress of the higher studies in Croatia from the time when Maria Theresa established the Society of Sciences. Many delegates of foreign or other Austro-Hungarian Academies were present at the ceremony (Krakow, Berlin, Bologna, Pesth), and delegates from the Servian societies of learning. It is expected that the new University will play a most important part in the civilisation of the East, and be indeed the vanguard of European science in that direction.

MUCH remains to be done in this respect if the information we collect from Levantine papers be correct. It appears that in one of the principal islands of the Greek Archipelago some poor women have been imprisoned and starved, under the charge of sorcery. They were arrested for having attracted a host of locusts to their native land. The locusts not retreating, the persecution was extended to the husbands of the wretched creatures.

THE International Commission of Geodesy will hold its next meeting in Paris, in accordance with the decision come to at Dresden, where it held its sitting this year. The Government will assign it a public building for its meetings.

MR. J. E. TAYLOR, F.G.S., has discovered a buried forest in the Orwell. The forest is represented by a layer of peat containing trunks, leaves, and fruits of the oak, elm, hazel, and fir, associated with which are the remains of the mammoth. A bed of freshwater shells containing species not now living in the Orwell underlies the peat. Mr. Taylor remarks that this submarine forest is contemporaneous with others along the coast which existed previous to the depression separating England from the Continent.

MR. J. E. TAYLOR, who has done so much to create an interest in science in Ipswich, is to give a course of twenty lectures (free) in that town during the coming winter, on "Plants: their Structures and Uses."

AN important discovery has been made at Highwood, near the village of Ashill, in Norfolk, consisting of a vast collection of Roman remains in an oak-lined well, 40 ft. deep. The Norfolk and Norwich Archæological Society visited the spot on the 16th inst., when the well, under the superintendence of Mr. Barton, was emptied of its contents by a number of workmen. The well contains a great variety of articles, the most abundant being urns, of which about 100 have been obtained; more than fifty of these are perfect, and many of most beautiful form and ornamentation. There is considerable doubt as to the purpose which these wells were intended to serve; there are other two at Ashill, and others have been found elsewhere.

THE *New Quarterly Magazine* for October contains, with other articles of general interest, a paper by Mr. Richard Jefferies on "Small Farms." The writer notes the enormous development of science in modern farming, saying: "New plans, new inventions and discoveries follow each other in constant succession. The capabilities of agriculture seem inexhaustible. The number of clever and intellectual men who turn their attention to it multiply daily. It has its colleges, its professors, its students, and it would require a great volume to describe the machinery alone that has been contrived of late years, and is now in the market. The chemistry of agriculture would fill many more such volumes. * Geology, botany, entomology, almost all the sciences, are pressing forward to its aid." Deprecating, in the present state of agricultural science, the advantages of small farms, Mr. Jefferies goes on to say: "The utility of bringing up a race of students instructed in chemistry, geology, entomology, mechanics, &c., in agricultural colleges, with the assistance of professors, if they are afterwards to be placed on small farms, is a matter of much doubt; they would have no room for the exercise of their attainments. . . . Whether it be considered from the tenant's own side, or from the labourer's, or from the landlord's, the balance of argument appears to be indisputably in favour of large farms. To the nation, to the ever-increasing population, the large farm offers a greater present produce, and possibilities of still further development. The political economist, who judges the prosperity of an occupation by the amount of capital attracted towards it, must also decide in its favour, for capital will never flow into small farms."

WE commend to the notice of the Goldsmiths' Company the letter from "A Jeweller's Assistant" in yesterday's *Times*. Let us hope that this, as well as the other wealthy City Companies, are now waking up to a sense of their responsibilities, and that they will lose no time in utilising the immense wealth at their disposal, and which has hitherto been utterly wasted, in the promotion of technical—which ultimately means scientific—education. Let them not provoke a "City Companies' Commission."

ON the 12th inst. was opened the London School of Medicine for Women. The Council had determined that no inaugural address should be given, and thus a day which the future may possibly prove to have been one of no little importance passed by unmarked more than by the fact that the first lecture had been given in a Medical School devoted exclusively to the teaching of the female sex. The school is now in full working order, and women can receive an education fitting them to practise medicine. The services obtained by this school need not stop short at preparing women for the medical profession. There are many branches of science allied to the study of Medicine, Chemistry, Botany, Comparative Anatomy, &c., in all of which

a course of lectures is given as part of the medical education. These subjects are separately adopted by men as a means of gaining a livelihood. A knowledge of any one of these subjects is attainable equally by women as by men, and there is no reason why women should not achieve a scientific reputation and earn a fair competency by engaging in these studies and by imparting their knowledge to others.

IT is announced by the last Indian mail that a smart shock of earthquake was experienced in Central Ceylon early on the morning of the 19th of September, at five o'clock. The vibration was considerable, and was accompanied by a dull rumbling sound. The motion was from east to west, apparently; the rumbling was decidedly in the east. The shock appears to have been felt in the centre of the island only. Earthquakes in Ceylon are such rare events that this one has had a good deal of attention bestowed upon it.

WE would draw the attention of our readers to the excellent introductory lecture delivered by Prof. Leoni Levi at King's College, on "The Educational and Economic Value of Museums and Exhibitions," which is published in the *Society of Arts Journal* for the 16th inst. He gives many valuable suggestions as to the uses for purposes of popular teaching which might be made of our museums. He thinks that London is still deficient in museums, and states that there are at least some two hundred cities and boroughs which have taken no step to secure museums and public libraries for themselves.

THE *Augsburg Allgemeine Zeitung* of the 22nd inst. gives the following facts and statistics from the various University Calendars just published:—The University of Berlin shows the largest attendance, having had, in the summer term of 1874, 2,980 students and 187 professors. While this University had for a time the second place and Leipzig the first, the order is now reversed, and Leipzig follows with 140 professors and 2,800 students. Then comes Halle, with 1,055 students and 95 professors; Breslau, with 1,036 students and 107 professors; Munich, with 1,031 students and 114 professors; Tübingen, 921 students and 84 professors; Würzburg, 901 students and 58 professors; Heidelberg, 884 students and 104 professors; Bonn, 858 students and 98 professors; Strassburg, 667 students, and 81 professors; Königsberg, 603 students and 76 professors; Greifswald, 540 students and 58 professors; Jena, 493 students and 69 professors; Münster, 451 students and 27 professors; Erlangen, 442 students and 51 professors; Marburg, 440 students and 62 professors; Gießen, 342 students and 58 professors; Freiburg, 297 students and 52 professors; Kiel, 210 students and 62 professors; Rostock, 132 students and 38 professors. In these numbers the non-matriculated students are also included. The German-speaking Universities outside the German Empire show the following attendance:—Basle, 163 students and 62 professors; Berne, 332 students and 63 professors; Zürich, 331 students and 75 professors; Dorpat, 768 students and 67 professors; Graz, 932 students and 68 professors; Innsbruck, 615 students and 52 professors; Prague, students (?) and 122 professors; Vienna, 3,615 students and 227 professors. Vienna, therefore, is at the present time the largest German University.

M. HURQUERLOT, a gentleman who was largely interested in railway speculations, died a few months ago and left a legacy of 24,000*l.* to the city of Paris for the purpose of establishing a railway school. But the sum, although very large, having been considered insufficient for the purpose, the Municipal Council has been reluctantly obliged to reject the money, which will revert to the lawful heirs.

MORE than 18,000 young men have gone successfully through their examinations, and have been admitted as volunteers for one year in the French army. About half of that number have been

rejected as not having received a sufficient education. The report of the examiners shows an improvement in the mean capacity of candidates. Many young men are admitted, without having to pass previous examinations, Bachelors of Arts, Sciences, or Letters, Pupils of Public Schools of Arts and Public Works and Mines, and Beaux Arts, and a few other institutions. The number of the volunteers of that class is about 4,000. Each volunteer has to pay besides a sum of 60*l.* to the Government. Education must be combined with money, in order to shorten the service in the remodelled French army.

THE study of "seaweeds" is probably affected as much by the general public as that of fish; and whether or not the great mass of people who visit the Brighton Aquarium and other similar resorts really go there with any idea of becoming more intimately acquainted with the wonders of the deep, there is no doubt that the exhibition of varieties of ocean plants would be as popular as that of fish. A seaweed growing in water is very different from seaweed cast up on the shore, and a careful selection and arrangement of specimens would greatly enhance the interest of the tanks, while at the same time their presence would prove beneficial to the fish. We recommend the hint to the notice of the authorities of the Brighton, Crystal Palace, and Southport Aquariums.

AN Industrial Exhibition is to be held at Leighton Buzzard for a short time about Whitsuntide 1875. The district to be represented is limited to a radius of twenty miles around Leighton Buzzard, and the proceeds of the exhibition will be devoted to the formation of a lecture fund for the purpose of securing courses of high class (largely scientific, we hope) public lectures in connection with the Working Men's Society, and the increase of the Society's library.

To increase the general instructiveness of their Museum, the Leeds Philosophical and Literary Society have published Descriptive Guides to the different collections of which it is composed. That on the British Birds, by Mr. L. C. Miall, is before us, containing a short and instructive account of each species exhibited. This method of combining instruction with amusement is one which it would be well if other public institutions were to adopt, instead of leaving their collections, often valuable ones, for the idle gaze of the many uninitiated, and the careful study of the but too few special students of special branches of science and art.

In many parts of the coasts of this country where fish are abundant, enormous quantities are used as manure: in Cornwall and on the Eastern coasts this is particularly the case, but no means are adopted to convert the fish into a manufactured manure, and they are thrown, as caught, on the land. The same remarks apply to America. But recently a system has been adopted in certain localities by which the fish are prepared specially for manuring the land. At Lucages, Long Island, a factory has recently been established, for preparing the surplus quantities of "Menhaden" caught near there. The oil is first extracted from the fish, and the residue is prepared in a certain manner and converted into "fish guano," which has a good reputation as a fertiliser.

ARRANGEMENTS have been made for placing on board one of the steamers running between Liverpool and New York, one of the "American Aquarium Cars," a newly invented contrivance for transporting live fish, which has succeeded very well in long overland journeys, and by means of which it is hoped to effect a useful interchange of living fish of various kinds between this country and America. There are many American fish which might with benefit be introduced into England, and we at the same time might transport to the other side of the Atlantic some varieties of fish which are not found there.

THE exhibition of insects in the Orangery of the Tuileries Gardens, Paris, has been brought to a close. The distribution of prizes took place on October 5. The higher medals were taken by a Viennese *savant* for a magnificent atlas exhibiting all the organs and forms of *Phylloxera vastatrix*; but the *Phylloxera* question is left open, and no reasonable solution appears to have been presented. Lectures were delivered daily on entomology, and every one of them was illustrated by projections with the solar microscope. Almost every kind of insect was thus presented to the public. The exhibition proved wonderfully successful; more than 20,000 persons paid the entrance fee, and the number of free tickets issued amounted to 30,000 in the brief space of twelve days.

WE have received a lecture on "The Life and Works of Dr. Priestley," delivered in Paris at the time of the celebration of the Priestley Centenary by M. W. de Fonvielle. It is published by Auguste Ghio, and is dated 1875.

THE additions to the Zoological Society's Gardens during the past week include a Bengalese Leopard Cat (*Felis bengalensis*) and a Common Paradoxure (*Paradoxurus typus*) from India, presented by Capt. W. Reynolds; a Great Eagle Owl (*Bubo maximus*), European, presented by Lord Londesborough; an Indian Fruit Bat (*Pteropus medius*) from India, presented by Dr. Stafford; a Monteiro's Galago (*Galago monteiri*) from Angola; a Tooth-billed Pigeon (*Didunculus strigirostris*) from the Samoan Islands, deposited; two Geoffroy's Doves (*Peristera geoffroyi*) from the Island of Fernando de Noronha, and a Gentoo Penguin (*Pygosceles taeniatus*) from the Falkland Islands, new to the collection, purchased.

KENT'S CAVERN*

BEFORE entering on this, their tenth Report, the committee desire to express their deep sense of the great loss they have sustained in the decease of Prof. Phillips. No member was more regular in his attendance at the meetings of the Committee or felt a livelier interest in the investigation with which they are charged. On March 18, 1874—little more than a month before his lamented death—though suffering from a severe cold, he visited the cavern, when he carefully inspected those branches of it which had been explored, and expressed his admiration of the clearness and importance of the evidence bearing on the question of human antiquity which had been obtained.

The investigation has been pursued without intermission during the entire period which has elapsed since the meeting at Bradford in 1873; the mode of operation has been that described in previous Reports and followed from the commencement; the work has been performed in the most satisfactory manner by the same workmen; and the superintendents have continued their daily visits and carefully recorded the results from day to day.

The interest felt in the exploration by the inhabitants and visitors of Torquay has suffered no abatement, and the superintendents have conducted a large number of persons through the cavern, including the members of the South-western Branch of the British Medical Association during a meeting of that body held at Torquay, and also the members of the Birmingham Natural History and Microscopical Society whilst on a scientific excursion to South Devon.

During May 1874, an arrangement was made with the superintendents by Prof. A. Newton of Cambridge, for Mr. Slater, one of the naturalists of the Rodrigues Transit Expedition, to spend some time in the cavern, studying the mode of exploration followed there; it being probable that he might have to explore some very interesting caves which exist in the island. Mr. Slater reached Torquay on the 1st of June, when everything was done to facilitate his purpose, and he spent some days watching the men at work.

Live rats continue to present themselves in the cavern from time to time, and prove occasionally to be very troublesome. Thus, in October 1873, one carried off six candles during the afternoon from a spot selected because it was believed to be in-

* Tenth Report of the Committee for Exploring Kent's Cavern, Devonshire. (Abstract.)